

# OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **TUCKER POND, SALISBURY**, the program coordinators have made the following observations and recommendations:

Thank you for your continued hard work sampling the pond this season! Your monitoring group sampled **three** times this season! As you know, multiple sampling events each season enable DES to more accurately detect water quality changes. Keep up the good work!

We encourage your monitoring group to formally participate in the DES Weed Watchers program, a volunteer program dedicated to monitoring lakes and ponds for the presence of exotic aquatic plants. This program only involves a small amount of time during the summer months. Volunteers survey their waterbody once a month from **June** through **September**. To survey, volunteers slowly boat, or even snorkel, around the perimeter of the waterbody and any islands it may contain. Using the materials provided in the Weed Watchers Kit, volunteers look for any species that are of suspicion. After a trip or two around the waterbody, volunteers will have a good knowledge of its plant community and will immediately notice even the most subtle changes. If a suspicious plant is found, the volunteers will send a specimen to DES for identification. If the plant specimen is an exotic, a biologist will visit the site to determine the extent of the problem and to formulate a management plan to control the nuisance infestation. Remember that early detection is the key to controlling the spread of exotic plants.

If you would like to help protect your lake or pond from exotic plant infestations, contact Amy Smagula, Exotic Species Program Coordinator, at 271-2248 or visit the Weed Watchers web page at [www.des.state.nh.us/wmb/exoticspecies/survey.htm](http://www.des.state.nh.us/wmb/exoticspecies/survey.htm).

**FIGURE INTERPRETATION**

- **Figure 1 and Table 1:** Figure 1 (Appendix A) shows the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the pond has been monitored through VLAP.

Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The median summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m<sup>3</sup>.**

The current year data (the top graph) show that the chlorophyll-a concentration **decreased greatly** from **June** to **July**, and then **decreased slightly** from **July** to **October**. It is important to point out that the **June** chlorophyll result was the **second-highest** result that has been measured since monitoring began in **1986**. It is likely that the chlorophyll concentration was **elevated** on the **June** sampling event due to the greater than normal amount of rainfall during the spring which likely contributed phosphorus-enriched stormwater runoff to the pond which stimulated algal growth.

The historical data (the bottom graph) show that the 2005 chlorophyll-a mean is **greater than** the state median and the similar lake median (for more information on the similar lake median, refer to Appendix F).

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual chlorophyll-a concentration has **not significantly changed** since monitoring began. Specifically, the chlorophyll-a concentration has **fluctuated between approximately 3 and 12 mg/m<sup>3</sup>**, but has **not continually increased or decreased** since **1986**. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.)

While algae are naturally present in all ponds, an excessive or increasing amount of any type is not welcomed. In freshwater ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase as nonpoint sources of phosphorus from the watershed increase, or as in-lake phosphorus sources increase (such as sediment phosphorus releases, known as internal loading). Therefore, it is extremely important for volunteer monitors to

continually educate all watershed residents about activities within the watershed that affect phosphorus loading and pond quality.

- **Figure 2 and Table 3:** Figure 2 (Appendix A) shows the historical and current year data for pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the pond has been monitored through VLAP.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The median summer transparency for New Hampshire's lakes and ponds is 3.2 meters.**

The current year data (the top graph) show that the in-lake transparency **increased** from **June** to **July**, and then **increased slightly** from **July** to **October**.

It is important to note that as the chlorophyll concentration **decreased** at the deep spot this season, the transparency **increased**. We typically expect this **inverse** relationship in lakes. As the amount of algal cells in the water **decreases**, the depth to which one can see into the water column typically **increases**.

The historical data (the bottom graph) show that the 2005 mean transparency is **slightly greater than** the state median and the similar lake median (refer to Appendix F for more information about the similar lake median).

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual transparency has **not significantly changed** since monitoring began. Specifically, the transparency has **fluctuated between approximately 2.7 and 4.9 meters**, and has **not continually increased or decreased** since **1986**. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.)

Typically, high intensity rainfall causes sediment erosion to flow into ponds and streams, thus increasing turbidity and decreasing clarity. Efforts should continually be made to stabilize stream banks, pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amount of epilimnetic (upper layer) phosphorus and hypolimnetic (lower layer) phosphorus; the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the pond has joined VLAP.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Excessive phosphorus in a pond can lead to increased plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration **decreased greatly** from **June** to **July**, and then **increased slightly** from **July** to **October**.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration **decreased greatly** from **June** to **July**, and then **decreased slightly** from **July** to **October**.

The turbidity and phosphorus concentration of the epilimnion and hypolimnion sample was **slightly elevated** on the **June** sampling event. This suggests that a rainstorm may have recently contributed stormwater runoff to the lake and/or that an algal bloom had occurred in the lake.

The historical data show that the 2005 mean epilimnetic and hypolimnetic phosphorus concentrations are **slightly greater than** the state median and the similar lake median (refer to Appendix F for more information about the similar lake median).

Overall, the statistical analysis of the historical data shows that the phosphorus concentration in the epilimnion (upper layer) has **not significantly changed** since monitoring began. Specifically, the phosphorus concentration has **fluctuated between approximately 7 and 24 ug/L** and has **not continually increased or decreased** since **1986**. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.)

Overall, the statistical analysis of the historical data shows that the phosphorus concentration in the hypolimnion (lower layer) has **significantly decreased** since monitoring began. Specifically, the phosphorus concentration in the hypolimnion has **decreased** (meaning **improved**) on average by **approximately 3.5 %** per

sampling season during the sampling period **1986** to **2005**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.) We hope this trend continues!

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and the recreational, economical, and ecological value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

#### **TABLE INTERPRETATION**

➤ **Table 2: Phytoplankton**

Table 2 (Appendix B) lists the current and historical phytoplankton species observed in the pond. Specifically, this table lists the three most dominant phytoplankton species observed in the sample and their relative abundance in the sample.

Due to an equipment problem, a phytoplankton sample was not collected on the **July** sampling event.

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

➤ **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The median pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.6**, which indicates that the surface waters in the state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean pH at the deep spot this season ranged from **6.64** in the hypolimnion to **6.65** in the epilimnion, which means that the water is ***slightly acidic***.

Due to the presence of granite bedrock in the state and acid deposition (from snowmelt, rainfall, and atmospheric particulates) in New Hampshire, there is not much that can be done to effectively increase pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 (Appendix B) presents the current year and historical epilimnetic ANC for each year the pond has been monitored through VLAP.

Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The median ANC value for New Hampshire's lakes and ponds is **4.9 mg/L**, which indicates that many lakes and ponds in the state are at least "moderately vulnerable" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) was **4.3 mg/L** this season, which is ***slightly less than*** the state median. In addition, this indicates that the pond is ***moderately vulnerable*** to acidic inputs (such as acid precipitation).

➤ **Table 6: Conductivity**

Table 6 (Appendix B) presents the current and historical conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current (which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column). The median conductivity value for New Hampshire's lakes and ponds is **40.0 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean annual conductivity in the epilimnion at the deep spot this season was **35.12 uMhos/cm**, which is ***slightly less than*** the state median.

The conductivity has ***gradually increased*** in the pond and inlets since monitoring began. Typically, sources of increased conductivity are due to human activity. These activities include failed or marginally functioning septic systems, agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing

conductivity. In addition, natural sources, such as iron and manganese deposits in bedrock, can influence conductivity.

We recommend that your monitoring group conduct a shoreline conductivity survey of the lake and the tributaries to help pinpoint the sources of **increasing** conductivity.

*To learn how to conduct a shoreline or tributary conductivity survey, please refer to the 2004 “Special Topic Article” or contact the VLAP Coordinator.*

It is possible that de-icing materials applied to nearby roadways during the winter months may be influencing the conductivity in the pond. In New Hampshire, the most commonly used de-icing material is salt (sodium chloride).

Therefore, we recommend that the **epilimnion** (upper layer) and the inlets be sampled for chloride next season. This sampling may help us pinpoint what areas of the watershed which are contributing to the increasing in-lake conductivity.

*Please note that there will be an additional cost for each of the chloride samples and that these samples must be analyzed at the DES laboratory in Concord. In addition, it is best to conduct chloride sampling in the spring as the snow is melting and during rain events.*

➤ **Table 8: Total Phosphorus**

Table 8 (Appendix B) presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae’s ability to grow and reproduce. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

In addition to the phosphorus concentration being **elevated** in the **epilimnion** and **hypolimnion** on the **June** sampling event, the phosphorous concentration was **elevated** in **Dead Man’s Inlet, Inlet #2, and the Outlet** on the **June** sampling event (**69, 91, and 37 ug/L, respectively**). The turbidity of each of these samples was **not** particularly elevated (**0.15, 0.19, and 0.56 NTUs, respectively**) which suggests that soil erosion was not a major contributor to the elevated phosphorus concentrations on the June sampling event. It is likely that the phosphorus concentration in the tributaries and in the lake is affected by the wetlands in the watershed which may contributing various forms of phosphorus. Due to the unusually high surface water levels that persisted during the spring and early summer of 2005 throughout most of the state, it is possible that phosphorus-enriched water, caused by increased rates of terrestrial

and wetland plant decomposition, was being released by the wetlands in the watershed which contributed to the elevated phosphorus concentrations in the tributaries and the lake. We are happy to report that the phosphorus concentration at the deep spot and in each of tributary sampling locations was much lower and typical on the July and October sampling events.

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2005 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

Due to an equipment problem, a dissolved oxygen/temperature profile was not conducted on the July sampling event.

➤ **Table 11: Turbidity**

Table 11 (Appendix B) lists the current year and historical data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

As discussed previously, the turbidity and phosphorus concentration of the epilimnion and hypolimnion sample was ***slightly elevated*** on the **June** sampling event. This suggests that a rainstorm may have recently contributed stormwater runoff to the lake and/or that an algal bloom had occurred in the lake.

➤ **Table 14: Current Year Biological and Chemical Raw Data**

This table lists the most current sampling season results. Since the maximum, minimum, and annual mean values for each parameter are not shown on this table, this table displays the current year “raw” (meaning unprocessed) data. The results are sorted by station, depth zone (epilimnion, metalimnion, and hypolimnion) and parameter.



➤ **Table 15: Station Table**

As of the Spring of 2004, all historical and current year VLAP data are included in the DES Environmental Monitoring Database (EMD). To facilitate the transfer of VLAP data into the EMD, a new station identification system had to be developed. While volunteer monitoring groups can still use the sampling station names that they have used in the past (and are most familiar with), an EMD station name also exists for each VLAP sampling location. For each station sampled at your pond, Table 15 identifies what EMD station name corresponds to the station names you have used in the past and will continue to use in the future.

### **DATA QUALITY ASSURANCE AND CONTROL**

#### **Annual Assessment Audit:**

During the annual visit to your pond, the biologist conducted a “Sampling Procedures Assessment Audit” for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor’s Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors fail to follow proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

#### **Sample Receipt Checklist:**

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did an **excellent** job when collecting samples and submitting them to the laboratory this season! Specifically, the members of your monitoring

group followed the proper field sampling procedures and there was no need for the laboratory staff to contact your group with questions, and no samples were rejected for analysis.

### **USEFUL RESOURCES**

*Acid Deposition Impacting New Hampshire's Ecosystems*, NHDES Fact Sheet ARD-32, (603) 271-2975 or [www.des.state.nh.us/factsheets/ard/ard-32.htm](http://www.des.state.nh.us/factsheets/ard/ard-32.htm).

*Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials*, NHDES Booklet WD-03-42, (603) 271-2975.

*Canada Geese Facts and Management Options*, NHDES Fact Sheet BB-53, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-53.htm](http://www.des.state.nh.us/factsheets/bb/bb-53.htm).

*Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms*, NHDES Fact Sheet WMB-10, (603) 271-2975 or [www.des.state.nh.us/factsheets/wmb/wmb-10.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-10.htm).

*Erosion Control for Construction in the Protected Shoreland Buffer Zone*, NHDES Fact Sheet WD-SP-1, (603) 271-2975 or [www.des.state.nh.us/factsheets/sp/sp-1.htm](http://www.des.state.nh.us/factsheets/sp/sp-1.htm).

*Low Impact Development Hydrologic Analysis*. Manual prepared by Prince George's County, Maryland, Department of Environmental Resources. July 1999. To access this document, visit [www.epa.gov/owow/nps/lid\\_hydr.pdf](http://www.epa.gov/owow/nps/lid_hydr.pdf) or call the EPA Water Resource Center at (202) 566-1736.

*Low Impact Development: Taking Steps to Protect New Hampshire's Surface Waters* NHDES Fact Sheet WD-WMB-16, (603) 271-2975 or [www.des.state.nh.us/factsheets/wmb/wmb-17.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-17.htm).

*Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act*, NHDES Fact Sheet WD-SP-2, (603) 271-2975 or [www.des.state.nh.us/factsheets/sp/sp-2.htm](http://www.des.state.nh.us/factsheets/sp/sp-2.htm).

*Road Salt and Water Quality*, NHDES Fact Sheet WD-WMB-4, (603) 271-2975 or [www.des.state.nh.us/factsheets/wmb/wmb-4.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-4.htm).

*Sand Dumping - Beach Construction*, NHDES Fact Sheet WD-BB-15, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-15.htm](http://www.des.state.nh.us/factsheets/bb/bb-15.htm).